IMPLICATIONS OF LONG TERM ROAD MAINTENANCE CONTRACTS FOR THE ASPHALT INDUSTRY

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1. SUMMARY

The introduction of long term road maintenance contracts (LTMCs) for roads will have significant implications for the asphalt industry. In the last few years, LTMCs have been on trial and/or adopted by road authorities in, amongst others, New South Wales, Tasmania, Queensland, Western Australia, New Zealand and South Africa. The drivers moving them forward are outside the control of the asphalt industry and will inexorably affect all members of the asphalt industry over time.

To understand their impact, models were developed of the market (in terms of bitumen sales) and the asphalt industry (asphalt/seal contractors and bitumen sellers). Then the effect of long term maintenance contracts was simulated. This caused substantial changes in bitumen supplier market shares. It changed asphalt/seal contractor market shares, and moved the market towards large contractors. There was a significant effect on plant utilisation, and subsequent plant levels needed.

There is also a knock-on impact outside the LTMC and into the local government arena, which will change the market at that level. The focus for education and research needs to be re-examined. The end result is substantial change in the asphalt industry.

2. INTRODUCTION

The introduction of long term road maintenance contracts (LTMCs) for roads will have significant implications for the asphalt industry. These contracts are being introduced as road authorities across the world are turning to structures that provide for the road authority to own the asset, and outsource the management and delivery. In the last few years, LTMCs have been on trial and/or adopted by road authorities in, amongst others, New South Wales, Tasmania, Queensland, Western Australia, New Zealand and South Africa.

The paper examines the changes in terms of the likely effects on the asphalt industry. To quantify some of these changes, models have been built which allow the changes to be simulated for Australia and South Africa. The simulation presented here is generic, with no individual singled out. At bitumen supplier level, simulation considers the effect of LTMCs on market share. At asphalt supplier/contractor level, where much of the impact will be felt, simulation considers market size and makeup, and plant utilisation.

The paper also considers the impacts of LTMCs on skills mix, QA/QC, corporate governance, education and research and development.

3. DRIVING THE GROWTH OF LONG TERM MAINTENANCE CONTRACTS

> *The road sector is big business. Many main road agencies are among the Fortune Global 500 (Fortune, 1996). The Japan Highway Public Corporation manages assets ($Aus 193 billion) roughly equal to those of General Motors and Sumitomo Life Insurance, the UK Highways Agency ($Aus 123 billion) is in the same league as IBM and AT&T, while a relatively small road agency like in South Africa ($Aus 11.2 billion) is in the same league as NorthWest Airlines and Fuji Electric*
> (Heggie and Vickers, 1998).

Most Governments recognise that public sector road agencies will function more efficiently if they are faced with some sort of competition. To provide this, Governments are increasingly turning to the option of unbundling services and contracting them out. In doing so, the road authority normally chooses the form of contract and the type of specifications to be used. Procedural (or method) specifications in which the client defines what work is to be carried out are traditionally used for roads – with good reason. They are relatively easy to identify and measure. But they require a lot of supervision and the contractor cannot easily change the design, works methods or materials; there are few incentives to encourage contractor innovation. In recent years these problems have led to a gradual move in some countries from procedural specifications towards performance (or functional or end product) specifications. Performance specifications encourage innovation as contractors find the best way of meeting the performance requirements.

Governments are also introducing efficiency measures to check how well their public sector agencies perform. Every year since 1995, Australia has published a performance monitoring report on State roads, containing data on 19 measures (Norwell and Youdale, 1997). At the same time, there is a move towards improving the financial reporting of agencies, by adopting income statements and balance sheets, based on regular commercial lines. Such efficiency measures include "Number of staff per 100 kilometres of road[1]" or "rate of return on capital". The measures are capable of being used in benchmarking across countries. Countries that are members of organisations such as OECD (which Australia is) will find that their efficiency is published and compared.

The drivers of LTMCs are therefore:

- the fact that roads are recognised as big business,
- Governments moving to manage their businesses better,
- performance specifications being introduced, and
- Government agencies being compared on their efficiency.

These are fundamental drivers, which come from the Society around us. Gallagher (1998) mentioned an Australian parliamentary recommendation that "the Commonwealth seek to achieve economies of scale and scope . . . by using contracts that . . . use long term maintenance periods".

These drivers are outside the control of the asphalt industry. Long term road maintenance contracts are one of the results of them. At the start of 2000, LTMCs sit astride 'innovators' and 'early adopters' on the product life cycle. Unless serious problems arise with LTMCs (and these are not apparent), then their usage is expected to be driven forward and they will inexorably affect all members of the asphalt industry over time.

[1] 1.8 for Transit New Zealand, 2.3 for South African National Roads Agency, but 15.2 for the UK Highways Agency (Heggie and Vickers, 1998)

4. BACKGROUND TO LONG TERM MAINTENANCE CONTRACTS

The introduction of long term maintenance contracts requires the following to have occurred (Heggie and Vickers, 1998; also see Frost and Lithgow, 1996, for discussion on how these elements were tackled in NSW):

- separation of planning/management and implementation in the road authority,
- development and acquisition of skills by local consulting and contracting industries,
- development of road agency skills in contracting procedures and administration,
- development of functional specifications, and
- effective quality assurance system.

The road authority puts these in place over time by proceeding through a series of contracts of increasing length and scope (Provis, 1998). The first stage is usually short (1 to 2 year) schedule of rates contracts. Then may come extended warranty contracts (Gallagher, 1998) or product guarantees (Verhaeghe et al, 1999). Then may come medium-term network contracts covering routine maintenance over small networks. In Latin America, driven by International Road Federation and German aid (Zietlow, 1998), Brazil, Chile, Colombia, Peru, and Guatemala have pilot projects on road networks of approximately 300 kilometres each, and typical contract duration of 3 to 5 years.

The next product is the long term (typically 10 year) performance based contracts for road maintenance. These have been variously termed PSM (performance specified maintenance), ROM (repair-operate-maintain), ROBMARC, or TNC (term network) contracts, and here will be generically termed long term maintenance contracts (LTMCs). In such contracts, the role of the contractor (who is the Provider), typically includes most or all of asset management, works planning and programming, design, implementation and operations.

Arguably the final product after LTMC is the Build Operate Transfer (or DCM) contract, of which both Australia and South Africa have several examples.

The status at January 2000 of LTMC in Australia[2] and South Africa is as follows:

South Africa
- SANRA (National Roads Agency) has in place short term network contracts covering routine maintenance over several hundred kilometres each.
- GJMC Johannesburg is working on the process of separation of planning/management and implementation in the road authority, and is expected to start short term network contracts soon.

Australia
- NSW has a single 10 year contract, covering about a third of the main roads in Sydney;
- Queensland has several pilot contracts in place (including one at the local authority level);
- Tasmania has a long term road maintenance contract in place in southern Tasmania (50% of its network);
- Western Australia has two 10-year contracts in place (one of 3000 kms, and one covering half the Perth Metropolitan area), and plans for another six similar contracts to be awarded very shortly. These will eventually cover 100% of its road network.

[2] Transit New Zealand are also very active in this field, with a State Highway and Auckland Harbour bridge LTMCs planned for award in 1999.

5. IMPLICATIONS OF LONG TERM MAINTENANCE CONTRACTS FOR THE ASPHALT INDUSTRY

The most immediate implications of LTMCs for the asphalt industry are in the areas of:

- bitumen sales;
- market share;
- contractor performance and position; and
- plant and equipment.

Because we are still in the early days of long term road maintenance contracts, the implications cannot be assessed simply by looking back at historical trends. Instead, a look into the future is needed and is done here using simulation techniques.

6. SIMULATION OF THE BITUMEN MARKET AND INDUSTRY

Simulation involves building a model of the market (in terms of bitumen sales) and a model of the industry (asphalt/seal contractors, and bitumen sellers). Then long term maintenance contracts could be introduced into the market in various ways, and the impact measured.

6.1 Market Model

A computer model of the asphalt industry market was developed. It is a composite one of South African and Australia roads, and is presented here as a generic model using data from both countries. Generic, because the commercial implications of long term road maintenance contracts could be significant, and it was considered necessary to keep this analysis non-specific. However the model and its data will be familiar to members of the asphalt industry in both countries.

The elements of the model are given in Table 1.

Table 1: Elements of Market Model

ELEMENT	PARAMETER
Road network and classification	Kilometres by national/state (or province)/local rural/local urban (b)
Surfaced/unsurfaced road mix	% by road classification
Surfacing area	Average surfacing width by road classification
Time between resurfacing (a)	Average years by road classification
Surfacing type	Concrete/asphalt/seal
Asphalt market	Asphalt surfacing per year/average overlay thickness by road classification
Seals market	Seals surfacing per year by road classification
Bitumen sales into asphalt	Average binder content by road classification
Bitumen sales into seals	Average application rate by road classification

Notes:

(a) the asphalt market in both countries is in the mature phase and bitumen sales for maintenance far outweigh sales for new construction. The exception is South Africa where new construction for BOT projects is generating significant sales. The bitumen sales for construction were factored into the model by reducing the time between resurfacing on National Roads to 10 years.

(b) In Australia the secondary level of government is termed State. In South Africa, it is termed Province.

For this paper, simulation was done at the national level, so national data were input to the model. Data representative of South Africa were used – Table 2 (adapted from Van Zyl, 1999)

Table 2: Road network and classification inputs to Market Model

ROAD NETWORK AND CLASSIFICATION	KILOMETRES
National highways	8000
State Highways	170000
Local Authorities (a)	118500

Notes (a) this includes rural District Councils, and Divisional Councils.

The bitumen market in South Africa is particularly depressed at this time, due to budgetary and institutional constraints at both State/Province and local authority level. The model was used to estimate bitumen sales by road classification both for the current (1999) depressed market, and for a normal market (1985). The results are shown in Table 3. Non-road uses including paints, roofing and pipes.

Table 3: Predicted and actual bitumen sales for two market situations

ROAD CLASSIFICATION	CURRENT DEPRESSED MARKET		HISTORIC NORMAL MARKET	
	Model prediction (tonnes)	Actual sales (all applications) (tonnes)	Model prediction (tonnes)	Actual sales (all applications) (tonnes)
National	55,680		55,680	
State/Province	80,940		134,901	
Local Authority	59,486		99,144	
Total (road)	196,107		289,725	
Non-road	15,689		23,178	
Total	211,795	**215,000** (a)	312,903	**310,000**

Notes: (a) Estimated based on sales to November 99.

The historic normal market prediction of 312,903 tonnes was used for further analysis in this paper, because it sits in between the current South African and Australia market sizes[3]. The model enabled seal and asphalt volumes to be predicted for the input parameters used (Table 4).

Table 4: Predicted market volumes segmented by surfacing type

MARKET	TONNES OF ASPHALT[4]	TONNES OF BITUMEN IN SEALS
National highways	614,400	21,888
State Highways	816,000	90,021
Local Authorities	874,800	51,030

[3] Obviously specific runs of the model can be done using any input parameters in response to specific questions or situations

[4] The 1999 South African market for asphalt is more like half this, which is seen if the model is run with the 1999 bitumen sales data as inputs. But using the 1985 bitumen sales figures gives the further analysis in this paper relevance for both South Africa and Australia.

6.2 Industry model

The industry model links asphalt/seal contractors and bitumen sellers (such as oil companies). The industry model was more difficult to build than the market model, because the asphalt industry operates at several levels. In both Australia and South Africa, there are national asphalt and/or seal contractors, there are contractors who are strong in only one State/Province, and there are local contractors who are strong in only one town/city.

The term "contractor" was used here loosely to mean either a surfacing contractor with their own supply and application equipment, and or a supplier who works with specialist (sub-) contractors to apply the product. This looseness is unfortunate, but attempts to tighten the definition led to over-complexity in the model without improvement in prediction.

The contractors in Australia and South Africa fall naturally into large, medium, small, and local categories. However the distribution varies geographically in each country. Johannesburg is very fragmented with many players compared to Cape Town, just as Perth is very fragmented with many players compared to Sydney. Several different models were tried to capture this, and all proved too complex. Eventually the model of Table 5 was adopted, which is still reasonably representative of the industry in both countries. Table 5 shows the market shares and number of contractors assigned to each of these different categories and it was used to build the picture of the industry.

Table 5: Contractor inputs to Industry Model

CATEGORY	MARKET SHARE PER CONTRACTOR	CONTRACTORS PER CATEGORY	MARKET SHARE SUBTOTAL
Large contractors	15%	3	45%
Medium contractors	8%	3	24%
Small contractors	5%	3	15%
Local contractors	1%	16	16%
		TOTAL	100%

In both Australia and South Africa, bitumen suppliers are mainly oil companies. The bitumen suppliers are linked geographically to their own refineries, but many often have drawing right agreements at other refineries that allow them to effectively have a national presence. There are typically one or two bitumen suppliers that choose to operate only in one geographic area, around their refinery. Rather then use the complex model of say three national bitumen suppliers and two local bitumen suppliers, it was assumed for this simulation that all the bitumen suppliers are nationally based and that there are four such suppliers of varying size in the country.

Table 6: Bitumen Suppliers in Industry Model

CATEGORY	MARKET SHARE				TOTAL
	Supplier A	Supplier B	Supplier C	Supplier D	
Large contractors	15%	15%	15%		45.00%
Medium contractors	4%	4%	8%	8%	24.00%
Small contractors	6%	2%	4%	3%	15.00%
Local contractors	4%	4%	4%	4%	16.00%
TOTAL	29.00%	25.00%	31.00%	15.00%	100.00%

The allocation of contractor to bitumen supplier was kept generic because of its commercial sensitivity. Provided that market share of the bitumen suppliers is in the right order (in the case of Table 6, this ranged from 15% to 31%), then changing individual allocations will not affect the magnitude of the impact of LTMCs on the asphalt industry. Despite the necessity to keep the models simple enough to be useful, and the need to make generic assumptions, they are considered to be representative of the bitumen market and industry. For the first time, the impact of long term road maintenance contracts on the asphalt industry can be measured.

7. EFFECT OF LTMC ON THE BITUMEN MARKET

The introduction of long term road maintenance contracts has the effect of taking roads out of the normal market place on a semi-permanent basis; i.e. the bitumen used in the LTMC is "lost" to the normal market.

If roads are taken out of the normal market place, the immediate effect is to shrink it. The same players are presumably still in the normal market place, and in the short term, the average percentage of normal market shares should remain unchanged. It is just that the market is smaller. This is probably the situation now prevailing in the markets where LTMCs have been introduced. Work is tight for those who are not involved in LTMCs.

However because the shrinkage is semi-permanent, in the medium term the players have to react to the shrinkage. The options are the same in any shrinking market:

Marketing
Phase out marginal products or activities;
Cut prices;
Phase out unprofitable areas;
Reduce non-core costs such as advertising, R&D, training, brand building.

Corporate Strategy
Abandon the market;
Reduce the number of players (and plants/equipment) by takeover of other players;
Decrease investment;
Exit.

The simulation allows these options to be weighed up by calculating the magnitude of short term change to be faced. The medium term has proved impossible to model so far, because of the diversity of options. For the short-term, two scenarios were modelled using the input data set; one approximating LTMC introduction to South Africa and one to Australia. Table 7 shows the amount of bitumen "lost" from the normal marketplace for the two scenarios as LTMCs are introduced.

Table 7: Bitumen "lost" from normal marketplace as LTMCs introduced

Road classification	Run 1 : possible scenario 5 years after the introduction of LTMC to South Africa	Run 2: possible scenario 6 years after introduction of LTMC into Australia
National	100% of network on LTMC	35% of network on LTMC
State/Province	20% of network on LTMC (2 State/Provinces)	35% of network on LTMC (2-3 State/Provinces)
Local Authority	10% of network	Nil
Original Market	312,903 tonnes	
Bitumen taken out of market	92,575 tonnes	66,703 tonnes

The bitumen is not lost, of course, but goes to the successful contractor/supplier. In the author's opinion, and based on the experiences with LTMCs in Australia to date, and given rules such as Main Roads Western Australia implemented to limit market dominance by any one contractor (Main Roads, 1996), the successful LTMC contractors will have the following characteristics:

- large (in resources in order to be able to handle the extremely high cost of tendering);
- efficient, cohesive and focussed (in order to put together the complex bid required);
- few in numbers (but more than one);
- from an engineering background (but not necessarily from the asphalt industry).

The LTMCs shown in Table 7 could eventuate in all sorts of combinations of contractors, but given the characteristics above and the realities of the contracting industry, the following combination is reasonable to anticipate:

- one contractor not from the asphalt industry (picking up say 25% of the bitumen "lost");
- one large contractor with more than one LTMC (picking up say 50% of bitumen "lost"); and
- one large contractor with one LTMC (picking up say 25% of bitumen "lost").

At first glance, this seems an arbitrary combination or allocation of contracts, which could be criticised for just being a single point look at the problem. However the key which makes the simulation process meaningful lies in the semi-permanent effect of taking roads out of the market place. This causes the shrinkage of the normal market place and the subsequent distortion, which is the main impact. The model simply translates this impact into practical dimensions such as market share change.

7.1 Bitumen suppliers

The introduction of LTMCs has implications for bitumen suppliers, especially those who have traditionally built their business on relationship (and price) marketing with contractors. The effect is substantial swings in market shares. The market share swing of course depends on who wins the LTMCs and who is aligned to which supplier, and the results shown in Table 8 obviously depend on the assumptions made. What is significant though is that whatever combinations were used, they all showed substantial change (up to 11 percentage points).

Table 8: Possible market share change for bitumen suppliers

MARKET SHARE SUPPLIERS	OIL A	OIL B	OIL C	OIL D
Normal market	29%	25%	31%	15%
Run 1 of Table 7				
After LTMC	32%	20%	21%	26%
Run 2 of Table 7				
After LTMC	31%	25%	24%	20%

7.2 Asphalt/seal contractors

The introduction of LTMCs also has implications for asphalt/seal contractors. The characteristics of successful LTMC contractors were noted above. The effect of LTMC will be a swing towards the large contractors, who have more of the required

characteristics. While medium and small contractors can increase their size by forming joint ventures, it takes such a single minded drive to be adequately efficient, cohesive and focussed that the large contractor may well have the advantage over the joint venture.

The effect on market share of the contractors will obviously depend on which contractors won which LTMC. However the trend to increasing market share for large contractors was consistent (Table 9). Experience with Build-Operate-Transfer projects shows that under a LTMC, some work will inevitably come down to the local contractors, but this is unlikely to be the high volume work offering potentials for high efficiency and returns.

Table 9: Possible market share change for contractors

MARKET SHARE CONTRACTORS	LARGE	MEDIUM	SMALL	LOCAL
Normal market	45%	24%	15%	16%
Run 1 of Table 7				
After LTMC	58%	18%	12%	12%
Run 2 of Table 7				
After LTMC	63%	16%	10%	11%

Not only will there be a change in market share, but in the author's opinion, there will also be a change in the nature of the contracting and the skills base required. To start with it is almost certain that the road authorities will require formal quality management systems to be in place to meet their need for an "effective quality assurance system". In the South African and Australian context, this means that the contractor will have to be certified to ISO 9000. Indeed, since the provider role includes design, the more onerous standard for design – ISO 9001 – can be anticipated.

Change has to come to LTMC contractors in terms of corporate governance because of the far greater control of the contractor over spending. In a normal contract, a specification sets out the scope of work, the contractor undertakes the work, and gets payment against progress every month. Expenditure by the contractor is via their operating budget. Even relatively junior members of the contractor's staff have the authority to incur significant expenditure such as ordering bitumen or stone.

In an LTMC, there is no scope of work setting out what has to be done each month, other than that which the contractor has done himself. Indeed, the contractor can do nothing, and still get paid every month[5]. Expenditure by the contractor on the contract falls somewhere between operating and capital expenditure. It will have a resemblance to capital expenditure simply because it is discretionary in nature. It will be much more difficult for a junior member of staff to make discretionary expenditure if there is no order from the client to do so, and corporate governance will be that much harder.

In operating LTMCs, the provider (contractor) therefore has to combine new levels of strategic, tactical and operational activities with sound financial judgement (Provis, 1998). This change opens the door to entry into the asphalt business for companies not traditionally associated with roads. Since LTMCs are essentially engineering management contracts, the skills to tender for and successfully run such contracts

[5] Figuratively speaking, of course.

are found in other enterprises, such as Transfield[6]. These new entrants will increase the competition for the traditional asphalt contractors. They will also have non-traditional alliances in terms of bitumen buying, plant purchases, and even sub-contractors, which will upset the balance.

7.3 Effect on plant and equipment

The effect of LTMCs on plant and equipment is to realise the long sought-for goal of good plant utilisation[7]. Indeed, the ability to control plant utilisation is one of the unrecognised benefits of these contracts. In South Africa, the excess of plant in the marketplace means that the utilisation level is low; an average of 40% is considered good for sprayers. The contractor in a LTMC has the ability to plan and group the work to maximise the utilisation of plant, and this can rise to a value of say 80%.[8] The effect of this high utilisation was simulated for sprayers (Table 10).

Table 10: Possible effect on sprayer market

ITEM	BEFORE	AFTER	
		LTMC	Normal market
Market (tonnes)	162,939	66703	96235
Sprayer utilisation	40%	80%	40%
Annual tonnes/sprayer	2880	5760	2880
Sprayers needed	57	12	33

The introduction of long term road maintenance contracts thus means a decrease in sprayers needed nationally from 57 to 45. The effect on the contractors who own the sprayers will depend on the age and financial status of the sprayer. In South Africa, where the industry typically comprises old equipment that was depreciated long ago, this simply means cutting up more sprayers. In Australia, where the industry typically comprises modern equipment, the impact could be more severe.

The LTMC will also affect the economics of sprayers. As sprayer utilisation changes from 40% to 80%, the charge-out rate (cost/day) could drop substantially, and sprayers owned by successful proponents of LTMCs will be less expensive than sprayers of other contractors. The same sort of effect will seen for asphalt plants, particularly those in metropolitan areas where LTMCs have been introduced.

7.4 Knock-on effect at local government level

Historically, State/Province road authorities have had strong formal and informal linkages with local authorities in their area. The State/Province road authority often sets standards, approves projects, and partly funds the road budgets of local authorities. It acts as the day-to-day road engineering reference point for local authorities. With the introduction of LTMCs at the State/Province level, that relationship will change to an extent as yet unknown. However it is clear that the operator of the LTMC will become an important player in the local roads arena.

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[6] Awarded the Sydney Metro 10-year roads contract in 1996. From the Web: "Transfield is a developer, owner, operator, and provider of engineering, construction, equipment and maintenance services across Australia and New Zealand and throughout Asia with an annual turnover of A$1.4 billion"

[7] Personal communication, Dave Orton, former Chairman of SABITA and Colas Southern Africa.

[8] This is a high utilisation in any industry; utilization above this is not usually possible due to delays with weather, construction etc.

The operator of the LTMC will be in a strong position to market to the local authorities in his area. After all, he is already operating a sophisticated pavement management system in the area. He will have road engineers resident in the area. His plant and equipment will be in the area, with their mobilisation costs already covered by the LTMC.

It adds up to a powerful marketing package, and the operator of a LTMC could expect to capture a very large share of the local authority market in his operating area. In most areas of South Africa and Australia, the length of surfaced roads under local authority control is as much or greater than the length of roads under State/Province control. By capturing many of these, it is possible that the operator of a LTMC could almost double his market over time. One innovative marketing approach could be for the operator of the LTMC to offer the local authorities their own 3/4 year mini-LTMC. It would cover their road networks using the management infrastructure already in place for the State/Province, and to the same high standard. With the cost benefits of already high plant utilisation, minimum mobilisation costs and market share muscle, this could be more than competitively priced.

7.5 Effect on industry staff and education

The LTMCs will affect the staff in the industry in terms of new skills being needed. In this type of contract, the provider requires sophisticated management and operational capability. In fact these contracts are as much about the management of assets as the physical delivery of maintenance services (Provis, 1998). The skills to manage these contracts are not easily found in contractors, or consultants, or suppliers, or road authorities. They are a blend of all these disciplines; with the one most overlooked being "Road Authority Management" skills. These are seen as the skills to manage assets year after year by juggling resources and time. The skill to judge when a reseal can be left another year because the money is needed to repair flood washaways now, but equally without blowing out the next year's sealing programme. The skill to leave a road network in good condition after ten years.

These "Road Authority Management" skills have traditionally been taught on the job – learning by experience – with senior road authority staff becoming very highly skilled individuals. For whatever reason, this management training has tended not to be formalised. Thus we have no Institute of Road Authority Management; unlike say aviation which has its College of Aeronautics at Cranfield, or Defence which has its Staff Colleges. To support Road Authority Management training, we have little published material outside of the technical engineering publications of pavement management groups, or the road engineering publications of AAPA, AustRoads, CSRA and SABITA.

Unfortunately, the various changes in road authorities and the downsizing to road agencies have, in the author's opinion, failed to adequately provide for the long term continuation of "Road Authority Management" training. At present it is not important, because there are plenty of road authority staff with those skills available for LTMCs. By the time the next round of LTMCs comes up in ten years time, that pool will have disappeared. So too will the mentors and informal trainers in the road authorities who could have taught the next generation or at least created some formal training.

This could put the industry too close for comfort to the picture sketched by Athol Yates writing on "Lessons from Accidents" in the Civil Engineer: January 2000

> *Serious questions about the way some engineering activities were being managed have arisen from coronial inquiries and government investigations into three major fatal accidents - the Royal Canberra Hospital implosion, the fire on HMAS*

Westralia, and the gas explosion at Esso's Longford facility. An analysis of the reports reveals that lack of technical expertise, inadequate engineering practice and failure to adequately assess competencies were contributing factors in these accidents.

As an industry, we are nowhere near there now, but unless specific steps are taken to address the impact of road authority change and LTMCs on education and training, we could find the industry there in 10 years time. Initiatives such as APSARC in Australia and the Master of Pavements from AAPA/Deakin University are laudable steps towards addressing technical education. With inputs and skills from Road Authorities, this could be extended to cover the gap in Road Authority Management training. Indeed, some road authorities, especially in South Africa, would enthusiastically welcome such training for their own staff right now.

The other issue to consider is that the use of technology in roads will change the nature of the education, and very different resource skills are going to be required to manage a highway network on a commercial basis. Certainly there has been a rapid growth in pavement management training and road asset management training in recent years since what was is believed to be the first PMS school in 1994[9]. Other rapid technology development is presenting highway network managers with new opportunities which never really existed only a decade ago (Dunlop, 1998).

7.6 Effect on research

The introduction of LTMCs has the potential to cause many changes in the industry: new entrants, changed alliances, changed bitumen marketing conditions, changes in contractor hierarchy, and changes in roles of road authorities. The change may also come through to research and publications.

The award of LTMCs is substantially based on price, and as the tenders are being put together, the key questions being asked of the asphalt industry (and the same questions asked in Build-Operate-Transfer tenders), are:

- how can we surface this road for the lowest cost and longest time?
- what is the life of this surfacing?
- what improvement in life will this modified bitumen give over unmodified bitumen?

They are very hard questions to answer right now. Gallagher (1998) gives a feel for the uncertainties as he talks about warranty periods. Yet only a very small part of our research and publications address the questions. For example, at CAPSA 99[10], the number of papers that addressed any of these questions was negligible, although the industry did better in understanding the issues (Table 11). The World of Asphalt Pavements 2000 conference promises more focus again.

Table 11: Paper focus at CAPSA 99

PAPER CONTENTS	NUMBER
Answered one or more questions	2
Better equipped industry to address new types of contracts such as PPGS, LTMC, performance based	12
Not related	>100

[9] Pavement Management School, University of Stellenbosch, June 1994

[10] The author was on the Steering, Technical Advisory and Marketing Committees, so takes part of the responsibility for its direction.

Yet is the asphalt industry still focussing enough on research and publications into the questions that will help the industry win its share of long term road maintenance contracts? Should more of our research and publications deliver papers with the sort of cost and productivity focus being found in other engineering disciplines? For example:

> Powell, M and Dalziel, S (1999) Dramatic Productivity Improvements in Ship Building at Marconi Marine (VSEL) Ltd. NorthStar Conference - accelerating the Aviation & Defence Supply Chain, Orlando, Florida

This issue needs to be debated when the industry in both countries next reviews its strategic plans and research programmes.

8. CONCLUSIONS

The drivers that are moving long term road maintenance contracts forward are outside the control of the asphalt industry and these contracts will inexorably affect all members of the asphalt industry over time. To understand their impact, models were developed of the market (in terms of bitumen sales) and the asphalt industry (asphalt/seal contractors and bitumen sellers). Then the effect of long term maintenance contracts was simulated. The simulation was based on the semi-permanent effect of LTMCs taking roads out of the normal market place. This caused substantial changes in bitumen supplier market shares, asphalt/seal contractor market shares, and plant utilisation.

There is also a knock-on impact outside the LTMC and into the local government arena, which will change the market at that level. Other impacts of LTMCs were the requirement for contractor quality systems and increasing the level of corporate governance for the contractor. The focus for education and research needs to be re-examined, and a need for Road Authority Management training addressed. The end result is substantial change in the asphalt industry.

DISCLAIMER

The modelling and views in this paper are those of the author. No road authority, industry association, oil company or contractor in any country has been involved in this modelling or analysis or had a preview of this paper.

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